IEEE NSW Joint Chapter PELS/IAS/IES Webinar

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Supercapacitor-assisted novel power electronic circuit topologies for DC Microgrid Applications

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Abstract

Over the last decade, electronics industry has seen many commercial versions of electrical double layer capacitors (EDLC), which are also known as ultra-capacitors and supercapacitors. The usual application scope of EDLCs is replacing the electrochemical batteries with their higher power density and moderately high energy density. An EDLC gives an approximately one million times larger capacitance compared to an electrolytic. In the current component markets, EDLCs come in capacitances vary from 0.2 to 7500 farads, with the limitation of very low DC voltage ratings from 0.7 V to 4 V. Recently some SC manufacturers have introduced a novel family of supercap-batteries where capacitance has gone up to 70,000 F. Joint work of power electronics research groups at the University of Waikato and AUT established the early scientific clues of using supercapacitors in the non-traditional application domain to develop novel power electronic circuit topologies. The success of the early projects was able to achieve the unique SCALoM theory in which the losses in the RC loop can be theoretically minimized by two combined steps namely; (i) adding a power electronics building block (PEBB) into RC the loop, and (ii) replacing the capacitor with a several orders larger device. Based on this concept, numerous supercapacitor-assisted (SCA) power converter circuit topologies have been investigated over the last 10 years of research work. In this seminar, the SCALoM Theory and the examples of successful SCA applications will be discussed including many patented or patent pending such as SCA low dropout regulator (SCALDO), SCA surge absorber (SCASA), SCA wide input PV inverter (SCAWI-PV Inverter) and SCA light emitting diodes (SCALED). With renewable energy

resources proliferating with DC loads such as data centres, variable speed drives and other internally DC driven domestic and industrial loads, SCA techniques' wide scope in the potential applications in DC Microgrid area will also be discussed.

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Biography:

Kosala Gunawardane received the B.Sc. degree (Hons.) in electronics and telecommunication engineering from the University of Moratuwa, Sri Lanka, in 2005, and the Ph.D. degree in electronics engineering from the University of Waikato, New Zealand, in 2014. She is currently a Senior Lecturer in electrical and electronics engineering with the Auckland University of Technology, New Zealand. Her research interests include analog circuit design, low-dropout regulators, supercapacitor-based applications, superconductor applications in power engineering, and DC-microgrid.

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Biography:

Nihal Kularatna is currently an Associate Professor in electrical engineering with the School of Engineering, University of Waikato, New Zealand. Being a recipient of the New Zealand innovator of the year award, in 2013, his electronic engineering career spans 42 years. He is currently active in research in supercapacitor applications, power supply topologies, transient propagation, and the power conditioning are in power electronics. He has contributed over 140 articles to journals and international conference proceedings. He has authored and coauthored nine reference books and several of them are in power electronics.